

## Reinhard Furrer

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## Research Interests

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Spatial and spatio-temporal statistics, non stationary processes, large datasets, robustness in geostatistics, ensemble Kalman filter, extreme value theory and statistical evaluation of atmospheric-ocean general circulation models.

## Education

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- May 2002      Doctoral thesis at the Swiss Federal Institute of Technology in Lausanne (EPFL): *Aspects of Modern Geostatistics: Nonstationarity, Covariance Estimation and State-Space Decompositions*.  
Advisor Prof. Stephan Morgenthaler.  
Jury: Prof. Anthony C. Davison, EPFL, Prof. Jürg Hüsler, University of Bern, Dr. Richard Webster, Rothamsted Experimental Station.
- March 1998     Diploma in Mathematics at EPFL.  
Undergraduate thesis: *Spatial statistics: Point processes and multivariate measures*.
- July 1997      Certificate of Applied Mathematics Teaching (CESMA), EPFL.
- 1993–1998     Undergraduate studies at EPFL including term projects: *The bi-optimal test of homogeneity of dispersions of  $k$  samples in S-PLUS*, *Multivariate kriging*, *Independence of two functions of random i.i.d. variables* and *Life expectancy in health care: methods, implementation, simulation*.
- July 1993      Scientific baccalaureate type C, College Spiritus Sanctus, Brig, Switzerland.
- June 1991      Graduation, North Kossuth High School, Iowa, USA.

## Professional Experience

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- 2005–          Assistant professor at the Department of Mathematical and Computer Sciences, Colorado School of Mines (CSM), Golden, CO, USA.
- 2002–2005     Postdoctoral fellow at the Geophysical Statistics Project, National Center for Atmospheric Research (NCAR), Boulder, CO, USA.
- 1998–2002     Research assistant at EPFL, Switzerland.

## Refereed Journal Publications

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- 1 Furrer, R. and Sain, S. R. (2008). Spatial Model Fitting for Large Datasets with Applications to Climate and Microarray Problems. *Statistics and Computing*, doi:10.1007/s11222-008-9075-x.
- 2 Mendez, P. F., Furrer, R., Ford, R. and Ordóñez F. (2008). Scaling Laws as a Tool of Materials Informatics. *JOM*, 60(03), 60–66.
- 3 Furrer, R., Sain, S. R., Nychka, D. and Meehl, G. A. (2007). Multivariate Bayesian Analysis of Atmosphere-Ocean General Circulation Models. *Environmental and Ecological Statistics*, 14(3), 249–266.
- 4 Furrer, R. and Bengtsson, T. (2007). Estimation of High-dimensional Prior and Posterior Covariance Matrices in Kalman Filter Variants. *Journal of Multivariate Analysis*, 98(2), 227–255.
- 5 Brändli, R. C., Bucheli, T. D., Kupper, T., Furrer, R., Stahel, W. A., Stadelmann, F. X. and Tarradellas, J. (2007). Organic pollutants in compost and digestate. Part 1. Polychlorinated biphenyls, polycyclic aromatic hydrocarbons and markers. *Journal of Environmental Monitoring*, 9, 456–464, doi:10.1039/b617101j.
- 6 Furrer, R., Knutti, R., Sain, S. R., Nychka, D. W. and Meehl, G. A. (2007). Spatial Patterns of Probabilistic Temperature Change Projections from a Multivariate Bayesian Analysis. *Geophysical Research Letters*, 34, L06711, doi:10.1029/2006GL027754.
- 7 Furrer, R. and Naveau, P. (2007). Probability Weighted Moments Properties for Small Samples. *Statistics and Probability Letters*, 77(2), 190–195.
- 8 Furrer, R., Genton, M. G. and Nychka, D. (2006). Covariance Tapering for Interpolation of Large Spatial Datasets. *Journal of Computational and Graphical Statistics*, 15(3), 502–523.
- 9 Plagellat, C., Kupper, T., Furrer, R., de Alencastroa, L. F., Grandjean, D. and Tarradellas, J. (2006). Concentrations and Specific Loads of UV Filters in Sewage Sludge Originating from a Monitoring Network in Switzerland. *Chemosphere*, 62, 915-925, doi:10.1016/j.chemosphere.2005.05.024.
- 10 Feingold, G., Furrer, R., Pilewskie, P., Remer L. A., Min, Q. and Jonsson H. (2006). Aerosol Indirect Effect Studies at Southern Great Plains during the May 2003 Intensive Operation Period. *Journal of Geophysical Research*, 111, D05S14, doi:10.1029/2004JD005648.
- 11 Fournier, B. and Furrer, R. (2005). Automatic Mapping in the Presence of Substitutive Errors: A Robust Kriging Approach. Extended Abstract in *Automatic mapping algorithms for routine and emergency monitoring data. Report on the Spatial Interpolation Comparison (SIC2004) exercise*, Dubois, G. ed. Office for Official Publications of the European Communities, Luxembourg, EUR 21595 EN, ISBN: 92-894-9400-X.
- 12 Fournier, B. and Furrer, R. (2005). Automatic Mapping in the Presence of Substitutive Errors: A Robust Kriging Approach. *Applied GIS*, 1(2), doi:10.2104/ag050012.
- 13 Brändli, R., Kupper, T., Bucheli, T. D., Furrer, R., Stadelmann, F. X. and Tarradellas, J.

- (2005). Persistent Organic Pollutants in Compost and its Input Materials – A Review of Field Studies. *Journal of Environmental Quality*, 34(3), 735–760.
- 14 Furrer, R. (2005). Covariance Estimation under Spatial Dependence. *Journal of Multivariate Analysis*, 94(2), 366–381.
  - 15 Kupper, T., Berset, J.D., Etter-Holzer, R., Furrer, R. and Tarradellas, J. (2004). Concentrations and Specific Loads of Polycyclic Musks in Sewage Sludge Originating from a Monitoring Network in Switzerland. *Chemosphere*, 54(8), 1111–1120.
  - 16 Genton, M. G. and Furrer, R. (2003). Analysis of Rainfall Data by Simple Good Sense: is Spatial Statistics Worth the Trouble?, in *Mapping radioactivity in the environment - Spatial Interpolation Comparison 97*, Dubois, G., Malczewski, J., and De Cort M. (eds), 45–50.
  - 17 Genton, M. G. and Furrer, R. (2003). Analysis of Rainfall Data by Robust Spatial Statistics using S+SpatialStats, in *Mapping radioactivity in the environment - Spatial Interpolation Comparison 97*, G. Dubois, J. Malczewski, M. De Cort (eds), 118–129.
  - 18 Furrer, R. (2002). *M*-Estimation for Dependent Random Variables. *Statistics and Probability Letters*, 57(4), 337–341.
  - 19 Furrer, R.(2000). On the Implementation of the Decomposition of Spatial Processes in MATLAB. *Computing Science and Statistics*, 32, 64–77.
  - 20 Furrer, R. and Genton, M. G. (1999). Robust Spatial Data Analysis of Lake Geneva Sediments with S+SpatialStats. *Systems Research and Information Science. Special Issue on Spatial Data: Neural Nets/Statistics*, 8(4), 257–272.
  - 21 Genton, M. G. and Furrer, R. (1998). Analysis of Rainfall Data by Robust Spatial Statistics using S+SPATIALSTATS. *Journal of Geographic Information and Decision Analysis*, 2(2), 126–136.
  - 22 Genton, M. G. and Furrer, R. (1998). Analysis of Rainfall Data by Simple Good Sense: is Spatial Statistics Worth the Trouble? *Journal of Geographic Information and Decision Analysis*, 2(2), 11–17.

## Other Refereed Publications

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- 23 Contributing author to Chapter 10 (*Global Climate Projections*) of the Working Group I contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report: *Climate Change 2007: The Physical Science Basis*, (2007), Cambridge University Press.

## Forthcoming Publications

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- 24 Kupper, T., de Alencastro, L. F., Gatsigazi, R., Furrer, R., Grandjean D. and Tarradellas J. (2008). Concentrations and specific loads of brominated flame retardants in sewage sludge. In press *Chemosphere*.

## Manuscripts in Preparation

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- 25 Furrer, R. and Genton, M. G., Aggregation-cokriging for Large Multivariate Spatial Datasets.
- 26 Furrer, R., Marier, A. F. and Boak, J., A Statistical Approach to Peak Oil.

## Research Reports and Conference Proceedings

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- 27 Furrer, R. and Sain, S. R. (2008) spam: A sparse matrix R package with emphasis on MCMC methods for Gaussian Markov random fields. *Technical Report MCS-05-08*. CSM.
- 28 Benigni, M. and Furrer, R. (2008). Periodic Spatio-Temporal Improvised Explosive Device Attack Pattern Analysis. *Technical Report MCS-04-08*. CSM.
- 29 Furrer, R. (2006). KriSp: An R Package for Covariance Tapered Kriging of Large Datasets Using Sparse Matrix Techniques. *Technical Report MCS-06-06*. CSM.
- 30 Brändli, R. C. *et. al.* (2006). Organic Pollutants in Source-Separated Compost. Short paper for *DIOXIN 2006*, Oslo, Norway.
- 31 Feingold, G., Furrer, R., Pilewskie, P., Remer L. A., Min, Q. and Jonsson H. (2005). Determining the Best-Estimate of Cloud Drop Size From a Variety of Remote Sensing Instruments. *Eos Trans. AGU*, 86(52), Fall Meet. Suppl., Abstract A22B-08.
- 32 Feingold, G., Furrer, R., Pilewskie, P., Remer L. A., Min, Q. and Jonsson H. (2005). A Weighted, Least-squares Approach to Determining the Best-estimate of Cloud Drop Size from a Variety of Remote Sensing Instruments. *Abstracts of the 24th Annual AAAR Conference, October 17-21, Austin, Texas*.
- 33 Tebaldi, C., Nychka, D., Mearns, L. O. and Furrer R. (2005). Inferring Climate from Climate Models. *55th Session of the International Statistical Institute, Sydney, Australia*.
- 34 Sain, S. R. and Furrer, R. (2004). Fitting Large-Scale Spatial Models with Applications to Microarray Data Analysis. *Proceedings of Interface 2004: Computational Biology and Bioinformatics*, Baltimore, Maryland.
- 35 Fournier, B., Furrer, R., Gsponer, T. and Restle, E.-M. (2003), Editors. Proceedings of the 13th European Young Statisticians Meeting, September 21-26, Ovronnaz, Switzerland, Stämpfli AG, ISBN 3-908152-17-8.
- 36 Naveau, P., Furrer, R. and Keckhut, P. (2003). The Spatio-temporal Influence of the Vortex on Artic Total Column Ozone Variability, in *The ISI International Conference on Environmental Statistics and Health*, Mateu, J., Holland, D. González-Manteiga, W. (eds), 131–140.
- 37 Fournier, B., Furrer, R., Gsponer, T. and Restle, E. (2001). Probabilités et statistique, collection des exercices. *Polycopié*, EPFL.
- 38 Furrer, R. (2001). Observation-State Representation of Non Stationary Spatial Processes. *Proceedings of the 12th European Young Statisticians Meeting, Jánska Dolina, Slovakia*, 15.

- 39 Furrer, R. (2001). Non Parametric Estimation within Decomposed Spatial Processes. *Proceedings of the International Conference of the Royal Statistical Society (RSS2001)*, University of Glasgow, Scotland, 51.
- 40 Kuonen, D. and Furrer, R. (2001). Data mining avec R dans un monde libre. *Flash Informatique Spécial Été*, EPFL, 45–50.
- 41 Furrer, R. and Kuonen, D. (2001). GRASS GIS et R : main dans la main dans un monde libre. *Flash Informatique Spécial Été*, EPFL, 51–56.
- 42 Furrer, R. (1999). Covariance Estimation under Spatial Dependence. *Proceedings in Spatial Temporal Modelling and its Applications*. Edited by Mardia, K. V., Aykroyd, R. G. and Dryden, I. L. Leeds University Press, Leeds, 137–140.
- 43 Furrer, R. Kuonen, D. and Picasso, M. (1999). La rédaction de documents scientifiques avec LaTeX. *Flash Informatique 2/99*, EPFL, 16–17.
- 44 Furrer, R. (1998). Principal Component Analysis of Lake Geneva Sediments. *Proceedings of the Fourth Annual Conference of the International Association for Mathematical Geology*. Edited by Buccianti, A., Nardi, G. and Potenza, R., De Frede Editore, Napoly, 421–426.

## Teaching Experience

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Spring 2008	Instructor for <i>Advanced Statistical Modelling</i> , MATH436/598, CSM.
Spring 2006, 2007, 2008	Instructor for <i>Introduction to Mathematical Statistics</i> , MACS435 (now MATH335), CSM.
Spring 2008	Instructor for independent study <i>Improvised Explosive Device Modeling with Inhomogeneous Spatio-Temporal Point Processes</i> , MATH599A, CSM.
Fall 2005, 2006, 2007	Instructor for <i>Introduction to Probability</i> , MACS434, (now MATH334) CSM.
Summer, Fall 2007	Instructor for independent studies <i>Introduction to Spatial Point Processes I/II</i> , MACS599A and MATH599A, CSM.
Spring 2007	Instructor for <i>Introduction to Applied Statistics</i> , MACS424/598, CSM.
Spring 2007	Instructor for <i>Senior Seminar II</i> , MACS462B, CSM.
Fall 2006	Instructor for independent study <i>R Programming Language</i> , MACS599B, CSM.
Spring 2003	Instructor for <i>Statistical Methods</i> , APPM4570/5570, University of Colorado, Boulder.
Fall 2002	Teaching assistant for <i>Differential Equations and Linear Algebra</i> , APPM2360, University of Colorado, Boulder.
March 2001	Instructor (joint with Prof. Morgenthaler and Dr. Kuonen) for <i>Probability and Statistics</i> given within the Postgraduate Cycle in Biomedical Engineering, LGM, EPFL.
June 2000, April 2001	Instructor (joint with Prof. Morgenthaler) for <i>Probability and Statistics</i> given within the Postgraduate Cycle in Risk and Security in Technical Systems, LMAF-DGM, EPFL.

March 2000, Nov. 2001	Instructor for <i>Probability and Statistics</i> given within the Postgraduate Cycle in Expertises of Real Estate, IREC-DA, EPFL.
June, Dec. 1999, April 2000	Instructor for two-day courses <i>Introduction to LaTeX</i> , Postformation, SIC, EPFL.
April, Oct. 1999, Feb., Oct. 2001	Instructor (joint with Dr. Kuonen) for two-day courses <i>Introduction to S-PLUS</i> , Postformation, DMA, EPFL.
1996–2002	Teaching assistant for undergraduate courses <i>Nonparametric and Robust Statistics</i> , <i>Nonlinear and generalized linear Models</i> , <i>Probability and Statistics I &amp; II</i> , and <i>Calculus III</i> , DMA, EPFL.
1993–1995	Substitute for lectures in mathematics and physics, College Spiritus Sanctus, Brig, Switzerland.

## Students

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Matthew Benigni	M.S., MACS, Spring 2008.
Norman Facas	M.S., Engineering, Co-advising with M. Mooney, expected fall 2008.
Ryan A. Ford	M.S., MACS, expected spring 2009.

## Invited Talks

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Aug. 2008	<i>Estimation of high-dimensional prior and posterior covariance matrices in Kalman filter variants.</i> Invited presentation at the JSM 2008, Denver, USA.
July 2008	<i>A Bayesian view of climate change: assessing uncertainties of general circulation model projections.</i> Invited presentation at the WCPS 2008, Singapore.
Feb. 2008	<i>Spatial Patterns of Probabilistic Temperature Change Projections from a Multivariate Bayesian Analysis.</i> 2nd Workshop on Climate Risk Assessment, JAMSTEC/FRCGC, Yokohama, Japan.
Oct. 2007	<i>Spatial Model Fitting for Large Datasets with Illustrations in Climate and Microarray Problems.</i> Department of Statistics, University of Wyoming, Laramie, USA.
July 2007	<i>Experiments on the Earth: Smoothing and spatial statistics for geophysical applications using fields.</i> Invited poster presentation joint with S. R. Sain and D. Nychka for JSM, 2007, Salt Lake City, USA.
May 2007	<i>Spatial patterns of probabilistic temperature change projections.</i> Workshop on the Application of Random Matrices Theory and Methods, SAMSI/IMAGE, NCAR, Boulder, USA.
Feb. 2006	<i>Sparse Matrix Techniques for Interpolation of Large Environmental and Biological Datasets.</i> Department of Preventive Medicine and Biometrics, University of Colorado at Denver, USA.
Sept. 2005	<i>A Small Statistical Contribution Towards a Global Picture.</i> Mathematical and Computer Sciences Departmental Colloquia, CSM, Golden, USA.

- June 2005 *Correlated Errors in Geophysical Applications*. Workshop on Computational and Mathematical Geoscience, CSM, Golden, USA.
- Oct. 2004 *Covariance Tapering for Interpolation of Large Spatial Datasets*. Department of Statistics, The Ohio State University, Columbus, USA.
- June 2004 *Ensembles in Numerical Weather Prediction and the Ensemble Kalman Filter*. INRS, Québec, Canada.
- April 2004 *Covariance Tapering for Interpolation of Large Spatial Datasets*. Department of Econometrics, University of Geneva, Geneva, Switzerland.
- April 2004 *The Kalman Filter and its Application in Numerical Weather Prediction*. Institute of Geography, University of Bern, Bern, Switzerland.
- July 2003 *Data Assimilation and the Ensemble Kalman Filter*. Chairs of Statistics, Institute of Mathematics, EPFL, Lausanne, Switzerland.
- Jan. 2003 *State-Space Decomposition of Geostatistical Processes*. Department of Applied Mathematics, University of Colorado, Boulder, USA.
- Nov. 2002 *State-Space Decomposition of Geostatistical Processes*. Department of Statistics, Colorado State University, Fort Collins, USA.
- Oct. 2002 *Covariance Functions and Nonstationary Processes*. Department of Applied Mathematics, University of Colorado, Boulder, USA.
- Feb. 2002 *Covariance Estimation of Geostatistical Data*, NCAR, Boulder, USA.
- Feb. 2002 *Nonstationarity in Geostatistical Modeling*, NCAR, Boulder, USA.
- Oct. 2001 *Représentation espace-état des processus spatiaux non stationnaires*, INRA, Avignon, France.

## Conference Presentations

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- Oct. 2006 *An Efficient Cokriging Approach Based on Canonical Correlation Analysis and Tapering and Estimation of High-dimensional Prior and Posterior Covariance Matrices in Kalman Filter Variants*. Poster presentations joint with M. G. Genton and T. Bengtsson at the conference *Multivariate Methods in Environmetrics*, Chicago, USA.
- Aug. 2006 *Spatial Patterns of Global Climate Change Fields*. Presentation at the JSM 2006, Seattle, USA.
- April 2006 *Probabilistic projections of climate change fields from a multivariate Bayesian analysis of climate model data*. Poster presentation joint with R. Knutti at the EGU General Assembly 2006, Vienna, Austria.
- March 2006 *Covariance tapering for Interpolation of Large Spatial Datasets*. Presentation in the contributed session ‘Advances in Spatial and Temporal Modeling’. 2006 ENAR Spring Meeting, Tampa, USA.
- Oct. 2005 *Optimal Estimation of Cloud Drop Effective Radius*. Presentation at the Special Symposium ‘Combining Multiple Data Sources and Models to Create an Accurate, Global Scale Aerosol Picture’ at the 24th Annual AAAR Conference, Austin, USA.

- July, Aug. 2004 *Spatial Hierarchical Bayes Model for AOGCM Climate Projections*. Presentation at the Graybill Conference, Fort Collins, USA and at the JSM 2004, Toronto, Canada.
- Sept. 2001 *Observation-State Representation of Non Stationary Spatial Processes*. Presentation at the 12th EYSM, Jánška Dolina, Slovakia.
- July 2001 *Non Parametric Estimation within Decomposed Spatial Processes*. Presentation at the RSS, Glasgow, Scotland.
- April 2000 *On the Decomposition of Spatial Processes*. Presentation at the Interface 2000, New Orleans, USA.
- July 1999 *Covariance Estimation under Spatial Dependence*. Poster presentation at the 18th LASR Workshop, Leeds, England.
- Oct. 1998 *Principal Component Analysis of Lake Geneva Sediments*. Poster presentation at the Forth Annual Conference of the IAMG, Ischia, Italy.

## Grants and Awards

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- Sept. 2006 PI: Non-stationary Spherical Processes to Synthesize Multimodel Climate Change Simulations, NSF-CMG DMS-0621118 (09/2006–09/2009, \$260K).
- Sept. 2003 Collaborator: Development of Spatio-Temporal and Multi-Resolution Methods for Detecting the Impact of Volcanic and Solar Forcings in Climate, NSF-CMG ATM-0327936 (09/2003–09/2006, \$300K). PI: P. Naveau.
- April 1998 *Prix Jean Landry* to reward a scientific work with original research within all EPFL diploma theses.
- July 1997 *Prix de la Société vaudoise des ingénieurs et architectes* to reward the student with the best grade in the third year at EPFL.
- Sept. 1992 First Prize at European Community Contest For Young Scientists for the project *Graphthal Plants and Varieties of Trees*.
- April 1992 First Prize at *Schweizer Jugend forscht* for the project *Graphtale Pflanzen und Häufigkeit von Bäumen*.

## Service to the Profession

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Organization of the topic-contributed session “Climate, Weather, and Spatial-temporal Models” at the Joint Statistical Meetings, August 6–10, 2006 in Seattle, USA (joint with S. R. Sain).

Organization of the 13th European Young Statistician Meeting, September 21–26, in Ovornnaz, Switzerland (joint with T. Gsponer, B. Fournier and E.-M. Restle).

Referee for *Climate of the Past*, *Computational Statistics and Data Analysis*, *Environmental and Ecological Statistics*, *Journal of Agricultural, Biological, and Environmental Statistics*, *Journal of Computational and Graphical Statistics*, *Journal of Climate*, *Journal of the Royal Statistical Society (B)*, *Meteorologische Zeitschrift*, *Nonlinear Processes in Geophysics*, *Technometrics*, *Statistica Sinica* and *Water Resources Research*.

Referee for NSF and NSERC proposals.

Referee for a Springer Verlag book proposal.

## Professional Memberships

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Member of the American Statistical Association, the Institute of Mathematical Statistics, the International Association of Mathematical Geology, the Swiss Statistical Society and the TeX Users Group.

## Collaborators

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*Statisticians:* T. Bengtsson (Lucent, USA), M. G. Genton (TAMU, USA), P. Naveau (IPSL, France), D. Nychka (NCAR, USA), S. R. Sain (NCAR, USA), L. Tenorio (CSM, USA).

*Scientists:* J. Boak (CSM, USA), G. Feingold (NOAA, USA), M. Geier (CSM, USA), R. Knutti (ETHZ, CH), T. Kupper (SCA, CH), G. A. Meehl (NCAR, USA), P. F. Mendez (CSM, USA), M. A. Mooney (CSM, USA).

## Languages

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German (mother tongue), English, French (fluently spoken, read and written), Spanish, Italian (read).

## Computing Skills

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Operating systems	Linux/Unix, Windows.
Programming	Fortran, C, HTML.
Applications	R/S-PLUS, Matlab, Mathematica, Maple, (La)TeX, MS-Office.